

WHAT IS CLAIMED IS:

1. A method of increasing a resolution of at least a portion of a reference frame of video, the method comprising the steps of:

5 selecting a first block of pixels in the reference frame;

locating, in N ( $N \geq 1$ ) target frames, one or more blocks of pixels that substantially correspond to the first block of pixels, where the N target frames are separate from the reference frame;

10 determining values of additional pixels based on values of pixels in the first block and on values of pixels in the one or more blocks; and

adding the additional pixels among the pixels in the first block.

15 2. A method according to Claim 1, wherein the N target frames comprise frames of video which were predicted, at least in part, based on pixels in the reference frame.

20 3. A method according to Claim 1, wherein the determining step determines the values of the additional pixels based also on coefficients which are weighted in accordance with the first block and the one or more blocks.

4. A method according to Claim 3, wherein the coefficients are weighted based on differences between pixels in the first block and pixels in each of the one or more blocks.

25 ~~Sub A1~~ 5. A method according to Claim 4, wherein the differences comprise an MPEG residual.

6. A method according to Claim 1, wherein, in a case that the locating step does not locate any blocks of pixels in the target frames that substantially correspond to the first block of pixels, the determining step determines the values of the additional pixels based on values of pixels in the first block without regard to values of pixels in the N target frames.

7. A method according to Claim 6, wherein the determining step determines the values of the additional pixels by performing bilinear interpolation using at least some of the pixels in the first block.

8. A method according to Claim 1, wherein the reference frame of video and the N target frames are coded using one of MPEG-1, MPEG-2 and MPEG-4.

9. A method according to Claim 8, wherein the reference frame comprises a bi-directional (B) frame; and wherein the method further comprises, before the selecting step, the step of determining a location of the first block in the reference frame based on blocks of pixels in frames which precede and which follow the reference frame.

10. A method according to Claim 8, wherein the reference frame comprises one of an intramode (I) frame and a predictive (P) frame; and wherein the N target frames comprise at least one of a P frame and a bi-directional (B) frame.

11. A method according to Claim 1, further comprising the step of changing distances between pixels in the first block in order to change a size of the first block.

12. A method according to Claim 1, wherein the locating step uses motion vectors from the reference frame to the target frame to locate the one or more blocks of pixels.

5 13. A method according to Claim 1, wherein the locating step searches through the N target frames to locate the one or more blocks of pixels.

10 14. Computer-executable process steps stored on a computer-readable medium, the computer-executable process steps to increase a resolution of at least a portion of a reference frame of video, the computer-executable process steps comprising:

code to select a first block of pixels in the reference frame;  
code to locate, in N ( $N \geq 1$ ) target frames, one or more blocks of pixels that substantially correspond to the first block of pixels, where the N  
15 target frames are separate from the reference frame;  
code to determine values of additional pixels based on values of pixels in the first block and on values of pixels in the one or more blocks; and  
code to add the additional pixels among the pixels in the first  
block.

20 15. Computer-executable process steps according to Claim 14, wherein the N target frames comprise frames of video which were predicted, at least in part, based on pixels in the reference frame.

25 16. Computer-executable process steps according to Claim 14, wherein the determining code determines the values of the additional pixels based also on coefficients which are weighted in accordance with the first block and the one or more blocks.

17. Computer-executable process steps according to Claim 16, wherein the coefficients are weighted based on differences between pixels in the first block and pixels in each of the one or more blocks.

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~~18. A method according to Claim 17, wherein the differences comprise an MPEG residual.~~

19. Computer-executable process steps according to Claim 14, wherein, in a case that the locating code does not locate any blocks of pixels in the target frames that substantially correspond to the first block of pixels, the determining code determines the values of the additional pixels based on values of pixels in the first block without regard to values of pixels in the N target frames.

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20. Computer-executable process steps according to Claim 19, wherein the determining code determines the values of the additional pixels by performing bilinear interpolation using at least some of the pixels in the first block.

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~~21. Computer-executable process steps according to Claim 14, wherein the reference frame of video and the N target frames are coded using one of MPEG-1, MPEG-2 and MPEG-4.~~

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~~22. Computer-executable process steps according to Claim 21, wherein the reference frame comprises a bi-directional (B) frame; and wherein the computer-executable process steps further comprise code to determine a location of the first block in the reference frame based on blocks of pixels in frames which precede and which follow the reference frame.~~

13. Computer-executable process steps according to Claim 21,  
wherein the reference frame comprises one of an intramode (I) frame and a  
predictive (P) frame; and

wherein the N target frames comprise at least one of a P frame  
and a bi-directional (B) frame.

24. Computer-executable process steps according to Claim 14,  
further comprising code to change distances between pixels in the first block in  
order to change a size of the first block.

25. Computer-executable process steps according to Claim 14,  
wherein the locating code uses motion vectors from the reference frame to the  
target frame to locate the one or more blocks of pixels.

26. Computer-executable process steps according to Claim 14,  
wherein the locating code searches through the N target frames to locate the one  
or more blocks of pixels.

27. An apparatus for increasing a resolution of at least a portion  
of a reference frame of video, the apparatus comprising:

a memory which stores computer-executable process steps; and

a processor which executes the process steps so as (i) to select a  
first block of pixels in the reference frame, (ii) to locate, in N ( $N \geq 1$ ) target  
frames, one or more blocks of pixels that substantially correspond to the first  
block of pixels, where the N target frames are separate from the reference  
frame, (iii) to determine values of additional pixels based on values of pixels in  
the first block and on values of pixels in the one or more blocks, and (iv) to add  
the additional pixels among the pixels in the first block.

28. An apparatus according to Claim 27, wherein the N target frames comprise frames of video which were predicted, at least in part, based on pixels in the reference frame.

5                    29. An apparatus according to Claim 27, wherein the processor determines the values of the additional pixels based also on coefficients which are weighted in accordance with the first block and the one or more blocks.

10                    30. An apparatus according to Claim 29, wherein the coefficients are weighted based on differences between pixels in the first block and pixels in each of the one or more blocks.

15                    ~~31. A method according to Claim 30, wherein the differences comprise an MPEG residual.~~

20                    32. An apparatus according to Claim 27, wherein, in a case that the processor does not locate any blocks of pixels in the target frames that substantially correspond to the first block of pixels, the processor determines the values of the additional pixels based on values of pixels in the first block without regard to values of pixels in the N target frames.

25                    33. An apparatus according to Claim 32, wherein the processor determines the values of the additional pixels by performing bilinear interpolation using at least some of the pixels in the first block.

~~34. An apparatus according to Claim 27, wherein the reference frame of video and the N target frames are coded using one of MPEG-1, MPEG-2 and MPEG-4.~~

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35. An apparatus according to Claim 34, wherein the reference frame comprises a bi-directional (B) frame; and wherein, before selecting the first block, the processor executes process steps so as to determine a location of the first block in the reference frame based on blocks of pixels in frames which precede and which follow the reference frame.

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36. An apparatus according to Claim 34, wherein the reference frame comprises one of an intramode (I) frame and a predictive (P) frame; and wherein the N target frames comprise at least one of a P frame and a bi-directional (B) frame.

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37. An apparatus according to Claim 27, wherein the processor executes process steps so as to change distances between pixels in the first block in order to change a size of the first block.

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38. A method according to Claim 27, wherein the processor uses motion vectors from the reference frame to the target frame to locate the one or more blocks of pixels.

39. A method according to Claim 27, wherein the processor searches through the N target frames to locate the one or more blocks of pixels.

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40. An apparatus for increasing a resolution of at least a portion of a reference frame of video, the apparatus comprising:  
means for selecting a first block of pixels in the reference frame;  
means for locating, in N ( $N \geq 1$ ) target frames, one or more blocks of pixels that substantially correspond to the first block of pixels, where the N target frames are separate from the reference frame;

means for determining values of additional pixels based on values of pixels in the first block and on values of pixels in the one or more blocks; and  
means for adding the additional pixels among the pixels in the first block.

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41. A television system which receives coded video data, and which forms images based on the coded video data, the television system comprising:

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a decoder which decodes the video data to produce frames of video;

a processor which increases a resolution of a reference frame of the video based on pixels in the reference frame and based on pixels in at least one other target frame of the video; and

a display which displays an image based on the reference frame.

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42. A television system according to Claim 41, wherein the processor increases the resolution of the reference frame by selecting blocks of pixels in the reference frame and, for each selected block, (i) locating, in N ( $N \geq 1$ ) target frames, one or more blocks of pixels that substantially correspond to the first block of pixels, where the N target frames are separate from the reference frame; (ii) determining values of additional pixels based on values of pixels in the selected block and on values of pixels in the one or more blocks, and (iii) adding the additional pixels among the pixels in the selected block.

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43. A television system according to Claim 41, wherein, in a case that the processor does not locate any blocks of pixels in the target frames that substantially correspond to the selected block of pixels, the processor determines the values of the additional pixels based on values of pixels in the selected block without regard to values of pixels in the N target frames.



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44. ~~A television system according to Claim 41, wherein the  
decoder and the processor are implemented in a settop box.~~

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45. A method according to Claim 4, wherein, in a case that the  
reference and target frames of video are coded using MPEG, the locating step  
locates the one or more blocks using motion vectors present in an MPEG  
bitstream for the target frames; and

wherein the coefficients are determined using DCT values of at  
least one coded residual, where the at least one coded residual comprises  
differences between the reference frame and the target frame(s).

46. Computer-executable process steps according to Claim 17,  
wherein, in a case that the reference and target frames of video are coded using  
MPEG, the locating code locates the one or more blocks using motion vectors  
present in an MPEG bitstream for the target frames; and

wherein the coefficients are determined using DCT values of at  
least one coded residual, where the at least one coded residual comprises  
differences between the reference frame and the target frame(s).

47. An apparatus according to Claim 30, wherein, in a case that  
the reference and target frames of video are coded using MPEG, the locating  
step locates the one or more blocks using motion vectors present in an MPEG  
bitstream for the target frames; and

wherein the coefficients are determined using DCT values of at  
least one coded residual, where the at least one coded residual comprises  
differences between the reference frame and the target frame(s).